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Performance Analysis of AODV, DSDV, and DSR Algorithms in MANET with Random Waypoint Model

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Abstract

Mobile Adhoc Networks (MANET) are ad-hoc networks that consist of mobile nodes that are autonomous, battery-powered devices that communicate through radio communication and they use some special routing algorithms for this task. These networks do not have any fixed infrastructure and that's why this network suffers from finding paths between the communication endpoints. There are various routing algorithms for MANET among which Dynamic Source Routing (DSR), Adhoc on-Demand Distance-Vector Routing (AODV), Destination Sequenced Distance-Vector Routing (DSDV) protocols are most common. In this paper, we studied these protocol's behaviors through simulation and made the performance analysis of these algorithms to find out which is the best one.

Keywords: MANET, DSDV, AODV, DSR, Random Waypoint model.

Introduction

Adhoc networks are categorized in two types, based on their mobility, Mobile Ad-hoc Networks (MANET) and Wireless Sensor Network (WSN)[1].In the recent years, researchers are devoting their time to implement a general purpose routing algorithm for mobile adhoc network. These routing algorithms are broadly classified into four categories-

Based on their routing information update mechanism: In this category, there are three types of routing algorithms- proactive, reactive and hybrid routing protocols. The main representatives of proactive routing protocols are DSDV [2]. . The main representatives of reactive routing protocols are AODV [3] and DSR [4]. Hybrid protocols are the combination of these two. Main representative is ZRP [5].

Based on the use of temporal information for routing: It is further classified into two categories-using past temporal information and using future temporal information.

Based on the routing topology: Those are two types-flat topology and hierarchical topology routing protocols.

Based on the utilization of specific resources: This is also of two subcategory-power-aware routing and geographical information assisted routing [6].

Among these categories, first one is most common. The proactive protocols are also called table driven routing protocols where each node maintains a routing table. The reactive protocols are also called on-demand routing protocols where each node does not maintain any routing table. They obtain the necessary path when it is required. The hybrid protocols are the best combination of features of above two categories. We have discussed some more about DSDV, AODV and DSR in the next section.

Rest of the paper is organized as follows: we outline the DSDV, AODV and DSR protocols and their improvement in section 2. The Random Waypoint model is discussed in section 3. Performance metrics those are required for simulation is discussed in section 4. Simulated results are shown in section 5.

Other related works are discussed in section 6. In section 7, we concluded which protocol is the best. Finally the scope of future work is discussed in section 8.

Preliminaris

Mobile adhoc routing protocols are of three types based on routing information update mechanism. They are Proactive routing protocols, Reactive routing protocols and Hybrid routing protocols. Most focused proactive routing protocol is DSDV and most focused reactive routing protocols are AODV and DSR. The brief description of the above algorithms are given below-

DSDV**:** - Destination Sequenced Distance Vector (DSDV) routing protocol is a hop-counting, proactive routing protocol in which each node of the network periodically exchange routing information. Loop-freedom is the main advantage of this algorithm. Each node maintains a routing table which consists of the distance of that node to all other nodes in the network. Each node periodically broadcast routing information to all other node. The route is selected by the distributed Bellman-Ford Algorithm (BFA) [7]. When a node receives some update information like broken-link or new-neighbor or route-updating, it waits for a settling-period before forwarding it, in case it receives some better route. In general, DSDV is suited for static or low mobility network.

AODV: - Adhoc On-demand Distance Vector (AODV) routing protocol is a reactive routing protocol in which routing information are exchanged only when a route is required for communication. A node first transmits a Route-Request (RREQ) to all other nodes. A route is determined when the RREQ reaches to the destination or to an intermediate node which has a fresh route to the destination. Then a Route-Reply (RREP) message is sent to the source by the reverse path. Then actual communication is started. During this communication, all the nodes of the route send hello messages to the source in a frequent time interval. If hello message is stopped from a node, then the neighbors assume that the particular node is move away and they informs all the nodes about this broken link. AODV avoids additional delay by using distance vector routing which is the main problem of other reactive routing protocols.

DSR**:** - Dynamic Source Routing (DSR) is another reactive or on-demand routing protocol which is based on source routing [8] i.e. source knows the complete hop-by-hop route to the destination. At the time of communication, nodes are simply forward the packet to the next node in the path. During communication, route failure information is detected by hop-by-hop acknowledgment or no broadcast has been received from a node for a while. At that time, the neighboring node which detects the failure confirms the sender about the damaged route and the route discovery phase is again initialized. The main difference between AODV and DSR is DSR does not use frequent control messages or hello messages for route maintenance.

Movement model

The most common movement model used in the research of wireless adhoc network is the random waypoint mobility model [9]. In this model, all the nodes choose a random destination and moves to the destination at a random speed which is between V_0 to V_{max}**.** Here V_0 is the lowest velocity of a node and V_{max} is the maximum velocity of a node. When a node reaches to the destination, it waits for a while called pause time and than again selects a random destination with a random speed and all the process is repeated until the simulation end.

We performed simulation in 7 different pause times 0, 30, 60,120,300,600,900 second in ns2 simulator. The number of nodes is 50 and the total simulation area is 1500mX300m. The total simulation time is 900 seconds.

Metrics

There are two approaches by which we can made performance analysis of routing algorithms in MANET. Using some network simulator to simulate the algorithms or experimenting with real hardware. In both case, the network environment parameters and the performance metrics are equally needed [10]. Those are given below,

Network environment parameters

The important network parameters for our simulation are given below:

Link Layer: LL represents the link layer used by mobile nodes. It has an ARP module connected to it. The ARP module resolves the address conversion between IP and MAC address.
ARP: The Address Resolution Protocol module receives quires from Link Layer.
Interface Queue: It gives the priority to the routing protocol packets. It inserted at the head of the queue.
Mac Layer: the MAC Layer uses a RTS/CTS/DATA/ACK patterns for unicast packets and only DATA pattern for broadcast packets.
Tap Agents: If an agent is permitted by a particular MAC protocol, the tap will be given to all packets received by that MAC layer.
Radio Propagation Model: At near distances, Friss-space attenuation (1/r2) is used and at far distances, an approximation to Two Ray Ground (1/r4) is used as a radio propagation model.
Antenna: An Omni-Directional antenna with unity gain is used.
Network Size: It is the number of nodes in the network.
Link Capacity: Bandwidth, BER etc.
Connectivity: It is the Number of neighbors of a node.
Mobility: The network topology, the speed of the nodes etc.

General performance metrics for routing protocols

The general four performance metrics are given below:

Throughput: It is the total number of packet received by the destination.
Packet Delivery Ratio: It is the ratio between the number of packets received by the destination and the number of packets generated by the source.
Average End-to-End Delay: It is the average delay time of all successfully delivered packets.
Packet Lost: It is the number of packets dropped by the routes due to errors, collisions, looping etc [11].

Simulation results

To get a better idea about the behavior of the routing protocols, we compare those with a 10 CBR connection. Figure: 1 shows the delivery rate with the pause time.

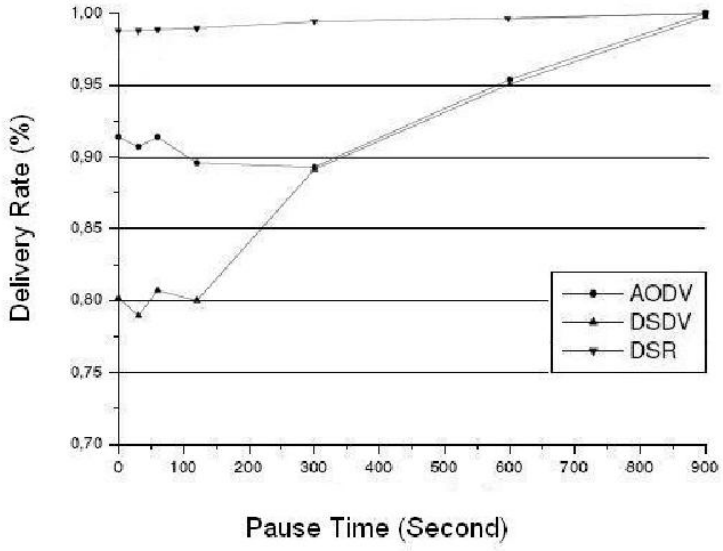

Fig 1. Performance Analysis with Delivery Rate and Pause Time

In low pause time, only DSR is able to deliver more than 95% packet. If the system mobility increases, then only DSR performs well i.e. in the lower pause time. When the pause time is more than 600 second, then AODV, DSDV and DSR are get close to each other i.e. in the high mobility.

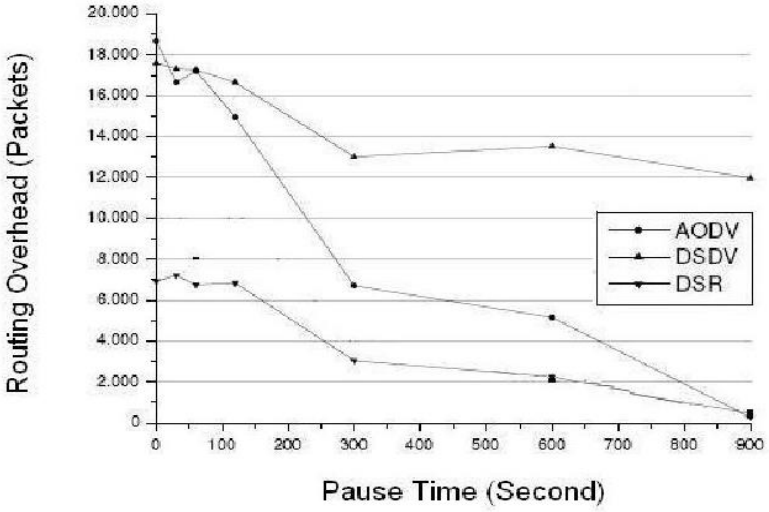

Fig 2. Performance Analysis with Routing Overhead and Pause Time

In high mobility situation DSR perform better than other two protocols because it has the smallest overhead. As pause time increases i.e. in the higher mobility situation, route failure occurs more frequently. Here again DSDV and AODV show poor performance by creating large number of packets.

Related Work

There are many paper have been published regarding the performance analysis of various routing algorithms in MANET. Among this algorithm or protocols Dynamic Source Routing (DSR), Adhoc on-Demand Distance-Vector Routing (AODV), Destination Sequenced Distance-Vector Routing (DSDV) protocols are most famous.

In ARM-DSDV [12] protocol, the two controls have two different duties. The update-content control maintains the route-demand metric and dynamically adjusts the content of routing updates, and the update-period control maintains the mobility metric, based on the rate of change in its neighborhoods.

Fisheye State Routing (FSR) [13] is another modification of DSDV. It sends updates to its nearby nodes more frequently than to its distant nodes.

Randomized-DSDV [14] randomizes the routing interval according to a routing probability distribution so that it eliminates the broadcast storm of simultaneous updates.

In DREAM [15], routing overhead can be reduced by making the rate at which route updates are sent analogous to the speed at which each node travels.

Conclusion

Reactive protocols like AODV and DSR are suited for high mobility network. The results are highly distributed by the network model and network parameters. But it can be said that for a general system configuration, DSR is much better than the other two protocols in terms of matrices like throughput, end-to-end delay, packet delivery rate etc.

Future work

Many studies can be performed regarding the performance analysis of routing protocols in MANET with different movement mobility model, different metrics and different system topology. We analyzed three protocols in this paper. Those are DSDV, AODV and DSR. Other protocols can also be analyzed using these same metrics and movement model.

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